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New Evidence of the Effect of Oil Revenues, Exchange Rates and Money Quantile ARDL Approach:Supply on CPI and PPI

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Abstract

The effect of oil revenue, exchange rate, and M2 on the CPI and PPI, over time of 2005:1-2022:1, was investigated in Iran with QARDL method. The results showed that in the short run, variables had an asymmetric effect on the CPI and the PPI. Oil revenues, in the long run, reached from the quantile of 0.05 to the median. The impact of the variable on the inflation increased, and then its impact decreased. Also, in the long run, the effect of the increase on the PPI is greater than the consumer price index. In the long run, the effect of exchange rates on the CPI and the PPI was nonlinear while being symmetric. It changed from the quantile of 0.2 to 0.8 and its effect proportionally increased and then decreased. Moreover, regarding M2, the results showed that the effect of this variable on the CPI and the PPI was asymmetric, in the short run. It changed from the middle quantile to the quantile of 0.9, and its effect was positive and significant. In the long run, the results confirmed its positive effect on inflation in all quantiles, although its effect on the PPI was asymmetric.

Highlights

- QARDL models also helps to examine the nonlinear dependence between all variables
- In the long run, the effect of exchange rates on the CPI and the PPI was nonlinear while being symmetric.
- In the long run, the increasing effect on the PPI is greater than the CPI.

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1. Introduction

Several consequences are brought about by the rise in oil earnings and its integration into the economies of oil-exporting nations like Iran. For instance, the inflow of oil profits has resulted in the development of fiscal policies that are more expansive, whereas the central bank's conversion of foreign exchange profits into local currency raises the money supply (M2) (Choi et al., 2018). This may cause the economy to experience inflation.

Since 2000, fluctuations in the price of crude oil around the world have sparked questions concerning how they might affect inflation. The price of energy-related products and services, which make up the CPI, should theoretically grow in direct proportion to the rise in domestic consumer prices when oil prices rise (Widarjono, 2019). Moreover, a rise in oil prices enhances energy prices, which indirectly raises producer cost index (PPI) (Sek, 2017).

An essential macroeconomic factor that could contribute to low inflation rates and a consistent funding system is the exchange rate (Deka et al., 2022). The question of how exchange rate variations were passed on to the price index was originally raised by Dornbusch in 1987. He discussed how an industrial structure's relative pricing are adjusted to exchange rate movements and volatility (Dornbusch, 1987). Due to the import of a variety of goods, Iran's economy also engages with the global economy, and local price levels are susceptible to external shocks such as changes in oil prices and rising or falling currency rates. Changes in exchange rates have an impact on the price of imported items, which then shocks the producer price and the consumer. Since every nation has a unique economic structure, the impact of fluctuating oil prices and currency exchange rates on price levels may differ between nations, necessitating attention in the country in issue (Zafar and Khan, 2022).

The Quintile Auto Regressive Distributed Lag (QARDL) model created by Cho et al. (2015) was used in this study to analyze the effects of the exchange rate, M2, and government oil income on the Consumer Price Index (CPI) and Producer Price Index (PPI). In this method, a number of dependent variable conditional distribution pattern can be used to explore both the relevant long-run and short-run relationships at the same time. By investigating short and long-run asymmetric relationships between dependent and independent variables, not only in the data distribution mean but also in the conditional distribution as a whole, the QARDL approach, in contrast to linear techniques, presents a more comprehensive view (Hammoudeh et al., 2022).

As a result, there are two improvements in the current study. Despite studying the impact of inflation in other nations, it has not yet been taken into account in Iran, despite the structure of the country's inflationary economy making it seem necessary. However, for the first time, inflation has been addressed briefly in the Iranian economy. The second important innovation of this research is the application of the QARDL approach, which is being employed for the first time in this study. In previous studies, the approach has not been used to analyze the asymmetric influence of short-term and long-term research factors.

2. A Review of the Related Literature

2.1. Theoretical Foundation

2.1.1. Effect of Oil Revenues on CPI and PPI

Because of the increased global oil prices in the exporting nations, oil export revenue will rise. Yet, price increases for oil have raised worldwide inflation and production costs (Rosnawintang et al., 2021). The price of imported products and services as well as the producer and consumer price indexes in the nations that export oil would eventually rise as a result of growing global commodity prices (Wen et al., 2021; Fenghua et al., 2021).

Rising oil prices in countries that import oil, first directly raise energy expenses for consumers and secondly raise the cost of producing goods and services for producers indirectly. The second stage, which is influenced by consumer and producer expectations, has a negative impact on investment and energy usage plans (Lacheheb & Sirag, 2019). The increase in the price of oil increased the manufacturing expenses, which in turn decreased the total supply and raised the level of the total price. As a result, a wage-price spiral was created, which led to an additional rise in consumer prices (Ibrahim & Said, 2012). Concurrently, it will decrease demands of the country due to the effects of real equilibrium, consumption and investment (Lardic & Mignon, 2008).

On the nature of how rising oil prices affect inflation, there is disagreement, though. On the one hand, increasing inflation reduces consumer need for products and services via four transmission broadcasts: (a) variations in available income (b) ambiguity over future energy costs (c) conservative savings, and (d) operative cost impacts (Edelstein & Kilian, 2009). The rising costs of creating goods and services from energy, on the other hand, have indirect consequences on manufacturing processes; however, more empirical literature is still needed to fully understand this (Castro et al., 2017).

2.1.2. Effect of Exchange Rates on CPI and PPI

As the economy grows progressively accessible, both of the two avenues for transferring, the exchange rate to national costs become more significant. The first instance of the direct transmission channel occurs when fluctuations in exchange rates have an impact on the import costs of manufacturing inputs. In this scenario, the producer price level is impacted, which then has an impact on the consumer price index (Prasertnukul et al., 2010). Another instance is when exchange rate changes have an impact on the import costs of final products, which subsequently have an impact on the level of local consumer prices (Hoang et al., 2020). The term "indirect exchange rate channel" describes how competitively priced items are on global markets. In the indirect transmitting channel, if domestically produced goods are primarily the primary production inputs, anticipating the producer exchange rate and hence, the consumer price amount will rise (Helmy et al., 2018); however, if domestically produced goods are the final products,

responding to increased prices from foreign competitors to retain their profit margin, the domestic manufacturers and retailers will increase their sale prices; therefore, the shocks will transmit to the consumer price (Camilleri et al., 2019).

In accordance to the weight of imported consumer products in the CPI, a rise in the currency price directly raises the consumer price index. Moreover, an increase in the exchange rate through production costs raises the producer price index, which indirectly influences both the price of imported goods and the price of domestic products in nations that are heavily dependent upon imported energy and intermediate inputs (Goldberg & Campa, 2010).

The exchange rate system is ultimately another influencing factor that affects the exchange rates to domestic prices. Economic stakeholders in a fixed system perceive exchange rate fluctuations as permanent, which will have a long-term effect on their production costs. As a result, they swiftly modify their sale pricing (Zen et al., 2020). In contrast, economic agents in a flexible exchange regime consider exchange rate fluctuations to be transient. Thus, companies do not instantly modify their sale prices (Usupbeyli & Ucak, 2020).

2.1.3. Effect of M2 on CPI and PPI

According to some economists (Davidson, 2006). The M2 is affected by factors including inflation, interest rates, and economic growth (Cyrille & Christophe, 2022). But, according to quantitative theory as well as other schools like monetarists and mercantilists, money is exogenous, which means that fluctuations in the supply of cash have an impact on variables like inflation (Thompson & Thompson, 2021).

The expansion of the money supply and inflation have a similar long-term relationship, according to the conventional quantity theory of money. The price level varies according to the identical direction and ratio as the money supply does (Zhu, 2021). Friedman, a leading proponent of the current quantity theory of money, contends that inflation only happens when the money supply expands at a faster growth rate than output (Friedman, 1970).

Because the amount of money in circulation and inflation in a given nation are linked to the main macroeconomic variables, the relationship between the two has always been a crucial one. In this respect, on the one hand, the primary influence on the cost of commodities, real consumer disposable income, interest rates, and other economic variables is the demand for money; all of these reveal the combined influence of fluctuations in the supply of cash (Lee & Yu, 2021). Yet, the money supply additionally has a significant effect on the level of prices and real income (He, 2012). Also, the connection between the expansion of the money supply and inflation serves as a basis for evaluating the success of monetary policy actions as well as preventing inflation expectations from increasing (Ryczkowski, 2021).

In the context of empirical studies, the expansion of the money supply affects inflation in a number of sub-periods in both positive and negative ways, and inflation has a similar influence on the money supply (Eita et al., 2021). For

instance, Mc Candless & Weber (1995) demonstrated that, over time, there is a strong link between the rise of the supply of cash and inflation. Considering the connection between money and prices, King (2002) demonstrates that as the time horizon gets shorter, the correlation between them weakens. The significant link between inflation and the rate of expansion of the money supply, according to Walsh (2003), lends some credence to the idea that expansion of the money supply is equivalent to a rise in the level of prices.

2.2. The Review of Empirical Studies

Sek et al. (2015) Used the ARDL model to analyze how changes in oil prices affected inflation in two sets of nations (groups with high and low dependence on oil). The findings indicate that while the variation in oil prices significantly influences domestic inflation in the oil-dependent group, it only indirectly affects domestic inflation in the high oil-dependent group because of fluctuations in the exporter's manufacturing costs.

Long & Liang (2018), utilized ARDL and NARDL systems to investigate the influence of oil prices on the Producer Price Index (PPI) and China Consumer Price. The long-term results indicated that the impacts of changes in the price of oil on China's consumer price indices was asymmetrical, and that the effects of rising oil prices on PPI and CPI overwhelm falling prices.

The asymmetric impact of oil prices and exchange rates on the inflation rates in Indonesia, Malaysia, and Thailand was studied by Husaini & Lean in 2021. The findings demonstrate that in all analyzed nations, the producer pricing index (PPI) is more significantly impacted by rising oil prices than the consumer price index is (CPI). Only Thailand, though, saw a large reduction in CPI and PPI as a result of lowering oil prices; in contrast, all three nations witnessed considerable increases in CPI and PPI as a result of exchange rate appreciation (also known as currency devaluation).

Using monthly data and VAR models, Zakaria et al. (2021) investigated the effects of the international price of oil on inflation in South Asian nations from 1980 to 2018. The estimated results demonstrated that the worldwide oil price shock had a considerable and long-lasting significant influence on inflation in South Asian nations. The dynamic analysis also demonstrated the unbalanced impact of the global price of oil on inflation.

From 1996: 10 to 2017: Six, Chen & Zhu (2021) conducted research in China using the SVAR model to examine how different oil price shocks affected the Industrial Producer Price Index (PPI). The findings showed that while industrial PPIs and rising oil prices resulting from both overall and specific need shocks are advancing in a similar manner, rising oil prices caused by oil supply shocks had a negative impact on China's industrial PPI.

ARDL and NARDL models were used by Altunöz (2022) to investigate the impacts of the price of oil intersections on the Consumer Price Index (CPI) and Producer Price Index (PPI) in Turkey. The results revealed that, over the long run, the impacts of oil price intersections on the Turkish consumer price index and the

producer price index are not symmetric; in other words, increasing prices of oil have a considerably greater impact on the consumer and manufacturer price indices and oil prices index.

Using Markov switching regression, Sek (2022) investigated the asymmetric impact of price fluctuations of oil on inflation in Malaysia. The findings demonstrate various partial domestic price inflation responses to fluctuations in oil prices. Oil is not the primary cause of domestic inflation, but its impacts on price inflation are asymmetric and it affects producer and industrial prices more than consumer prices. Total supply and demand are the primary factors of the actual exchange rate inflation. Furthermore, policy choices have an impact on price consistency.

Anderl & Caporale (2023) study the non-linearity of the currency rate to consumer and import prices by estimating the smooth transition regression model with various systems of inflation expectations for five inflation aiming nations (UK, Canada, Australia, New Zealand, and Sweden). The findings demonstrate that stabilizing inflation expectations contributes to reducing ERPT, and that in nations where inflation is a target, inflation expectations have a greater impact on ERPT.

Using the VECM model, Liu et al. (2017) looked at how the exchange rate (ER) affected domestic pricing in China. The study's findings indicate that the impact of Exchange Rate Pass through on domestic prices was limited but expanding. The Chinese government's announcement of a change to the ER regime in 2005 appears to have made the ER transition more sensitive to domestic prices.

Using a regression model with time-varying parameters and the Kalman filter method, Alizadeh Klagar et al. (2021) investigated how the inflation rate changed over time in response to key factors, particularly the money supply. An analysis of the changes in the growth rates of M2, inflation, and GDP growth rates reveals that, in the majority of years, the growth rate of M2 has had a positive impact on the inflation rate of the following period. However, during a specific period, the rate of inflation of the following period has greatly reduced despite a rise in the rate of growth of M2.

The goal of this study, conducted by Barakchian et al. in 2021, is to look into the relationship that existed in Iran for the previous three decades between the consumer price index and the exchange rate. Compelling evidence of a causative relationship between the exchange rate and the consumer price index, particularly over extended time horizons, is shown by the findings of the Granger causality test in the frequency space (more than 5 seasons). According to wavelet analysis, the fluctuating exchange rate has been a key element in explaining the consumer price index's movements during financial instability, both in the short and long terms.

In a study employing a threshold vector auto regression model, Tahsili (2022) conducted a non-linear analysis of the fluctuations in the exchange rate in Iran between the years 1369:1 and 1397:4. The findings demonstrated that the

impact of exchange rates on the overall level of prices is influenced by inflation values; as a result, if seasonal inflation is greater than 48.5%, the impact of currency shocks on inflation is lessened. The research findings show that the impact of an exchange rate shock on inflation is less than 48.5% because Iran's economy does not have an inflation targeting strategy.

According to Mohammadipour et al. (2020), a thorough New Keynesian dynamic stochastic general equilibrium model is emulated, and the shocks on the two crucial routes of the monetary base and the government's oil profits are interpreted. This study emphasizes on the design of the four paths of oil and energy impact on Iran's economy. The monetary impulse has beneficial impacts on nominal and real exchange rates, business investment, employment, production, import of consumer and capital goods, and the urge of foreign exchange oil revenues in addition to having a positive impact on inflation. Additionally, the level of general prices, imports of capital and consumer goods, and consumer expenditure in the first period enhances the demand part of the economy in a cross-sectional way and boosts non-oil production by 0.8%. This is due to an increase in government construction and current expenses.

Based on seasonal data for the years 1370 to 1397, Hashemi et al. (2019) conducted an analysis of the relationship between inflation and exchange rate by taking into account the exchange rates tension index and the level of intervention from central banks in Iran's economy. The country's inflation has increased by 26, 28, and 56%, respectively, based on the estimated findings of the SVAR model, an impulse from the region of oil income, an impulse from the area of currency market tension, and an urge from the central bank's intervention.

Using the vector auto correlation (VAR) model, Mahdavi Adeli et al. (2011) examined the impact of changes in oil prices on the variables of government capital expenses, gross domestic product, money supply, and inflation rate in Iran between 1350 and 1386. The findings demonstrate that changes in the price of oil have a favorable impact on the desired variables, and that oil prices are mostly responsible for explanatory variance of the error in the inflation rate and money supply predictions.

We use the QARDL model in this work to find the effects of government oil revenue, the exchange rate, and M2 on price inflation for both CPI and PPI, extending previous research. In order to do this, build upon Husaini et al. (2019a), Sek (2017), and Lachebeh & Sirag (2017) by focusing on government oil income rather than oil price because Iran's economic constraints prevent increased oil prices from always translating into higher government revenues. Because Husaini & Lean (2021) and other earlier works in this field employed the NARDL technique, we additionally increase the empirical contribution by employing the QARDL model.

3. Methodology

In the present study, in order to investigate the long and short effects of macroeconomic variables on the consumer and producer index, the

QARDL[1]method, introduced by Cho et al. (2015) was applied to investigate the effect of the short and long run asymmetric effects of different dependent variables were used. Hence, it may be necessary to introduce this method. Koenker & Bassett (1978) used quantile regression approach as an alternative to least square regression that have It has more advantages than conventional methods (Koenker & Hallock, 2001; Koenker, 2004).

In Various studies, the ARDL models showed several advantages over the other models. first, providing the sample size is small, the results of the estimates will be reliable. the other one is that, without considering the integration degree of variables is zero or one, the method can be used (Salah et al., 2022). The conventional models, such as VECM or VAR, can only be used if variables have the same integration degree (Koondhar et al., 2021). The third advantage of using the ARDL is that the ECM equation can be derived based on it. Fourth, in ARDL models, the issue of endogeneity is the least of the problems; because in these models there is no correlation in the error component (Pesaran et al., 2001). there is also a problem; if the variables are integrated of the second degree, the ARDL methods cannot be used. accordingly, and considering the mentioned advantages, in the present study, the family of ARDL models has been used to estimate the coefficients.

In addition to the above, the QARDL model has other advantages. This model provides the long-run equilibrium effect of dependent variable and simultaneously examines the long and short term relationship of variables in different quantiles. QARDL models also helps to examine the nonlinear dependence between all variables; it is an advantage over the conventional regression models that focus on a linear relationship through the mean of the estimators. in addition, the application of the QARDL model is a justification for examining the changes based on different quantiles in the time series. also, the other discussed feature is to examine the nonlinear relationship between the variables, and to provide the possibility to stabilize the coefficients in different quantities, by using the Wald test simultaneously (Abbass et al. 2022).

Another noteworthy point about QARDL models compared to NARDL models introduced by Shine et al. (2014) is that, unlike the mentioned models, in this method, instead of measuring the effect intensity compared to zero, the subject is examined by a data-driven base on quantile (Jiang et al., 2021).

In the present study, the quarterly data related to the Iranian economy was used for the period of 2005:1-2022:1, and the basis of the research model, is the ARDL form as follows:

$$PI_t = \mu + \sum_{i=1}^{p} \delta_i PI_{t-i} + \sum_{i=0}^{q} \theta_i OIL_{t-i} + \sum_{i=0}^{r} \kappa_i ER_{t-i} + \sum_{i=0}^{s} \omega_i M_{t-i} + \epsilon_t \quad (1)$$

In the above relation, ϵ_t represents the error component, and p, q, r, and s represent the number of lags, which is determined with SC[2]. Also in the above

[1] Quantile Auto Regressive Distributed Lag
[2] Schwartz Criterion (SC)

equation, the variables PI, OIL, ER, and M are the price index (consumer and producer price index), government oil revenue, exchange rate, and money supply, respectively.

Equation 1, in form of quantile regression, introduced by Cho et al. (2015) could be illustrated in QARDL (p,q,r,s) form as follows:

$$Q_{PI_t} = \mu(\tau) + \sum_{i=1}^{p} \delta_i(\tau) PI_{t-i} + \sum_{i=0}^{q} \theta_i(\tau) OIL_{t-i} + \sum_{i=0}^{r} \kappa_i(\tau) ER_{t-i} + \sum_{i=0}^{s} \omega_i(\tau) M_{t-i} \epsilon_t(\tau) \quad (2)$$

In the above equation $\epsilon_t(\tau) = PI_t - Q_{PI_t}(\tau/\delta_{t-1})$ and $0 > \tau < 1$ indicates the quantile (Anwar et al., 2021). also, due to the possibility of serial correlation, the above QARDL model can be generalized as follows:

$$Q_{PI_t} = \mu(\tau) + \rho PI_{t-1} + \phi_{CPI} OIL_{t-1} + \phi_{ER} ER_{t-1} + \phi_{BT} M_{t-1} + \sum_{i=1}^{p} \partial_i \Delta PI_{t-i} + \sum_{i=0}^{q} \theta_i \Delta OIL_{t-i} + \sum_{i=0}^{r} \kappa_i \Delta ER_{t-i} + \sum_{i=0}^{s} \omega_i \Delta M_{t-i} + \epsilon_t(\tau) \quad (3)$$

The above-generalized form could be shown in the QARDL-ECM error correction form as follows too:

$$Q_{\Delta PI_t} = \mu(\tau) + \rho(\tau)(PI_{t-1} - \beta_{OIL}(\tau) OIL_{t-1} - \beta_{ER}(\tau) ER_{t-1} - \beta_M(\tau) M_{t-1}) + \sum_{i=1}^{p-1} \partial_i(\tau) \Delta PI_{t-i} + \sum_{i=0}^{q-1} \theta_i(\tau) \Delta OIL_{t-i} + \sum_{i=0}^{r-1} \kappa_i(\tau) \Delta ER_{t-i} + \sum_{i=0}^{s-1} \omega_i(\tau) \Delta M_{t-i} + \epsilon_t(\tau) \quad (4)$$

Using the Delta method, the cumulative short-term effect of the previous period price index on the current period price index was determined as follows:

$$\partial_* = \sum_{i-1}^{p-1} \partial \partial_j \quad (5)$$

Similarly, the cumulative short-term effect of the previous period and the current period of the OIL, ER, and M variables was determined based on the following relationships:

$$\theta_* = \sum_{i-1}^{q-1} \partial \theta_j \quad , \quad \kappa_* = \sum_{i-1}^{r-1} \partial k_j \quad , \quad \omega_* = \sum_{i-1}^{s-1} \partial \omega_j \quad (6)$$

The long-run accumulation coefficients of the above variables would be calculated from the following equations, as well:

$$\beta_{OIL^*} = -\frac{\beta_{OIL}}{\rho} \quad , \quad \beta_{ER^*} = -\frac{\beta_{ER}}{\rho} \quad , \quad \beta_{M^*} = -\frac{\beta_M}{\rho} \quad (7)$$

Cho et al. (2015) introduced the Wald test to test the short and long term asymmetric effect of variables of government oil revenue, exchange rate, and M2 on the price index for the following hypothesis:

$$H_0: \rho_*(0.05) = \rho_*(0.1) = \rho_*(0.2) = \cdots \rho_*(0.95) \quad (8)$$

This test is performed separately for all the short-term and the long-term coefficients.

4. Results

In this study, the long and short term effect of variables of government oil revenue, exchange rate, and M2 on CPI and PPI were been investigated (in two separate equations). For this purpose, the results of descriptive statistics collected are presented in Table 1. As the data in table 1 shows, according to Jarque-Bera Test, the null hypothesis of zero normality of dependent variable data was rejected at the 99% confidence level, which indicates that the research data is abnormal

(except for the M2 variable). Therefore, due to the non-normality of dependent variables, the use of the quantile-based methods could be better than the mean-based methods.

Table 1. Statistical description of research data

	LCPI	LPPI	LOIL	LEX	LM2
Average	4.06	4.42	11.47	10.16	15.41
Middle	4.15	4.33	11.58	10.32	15.36
Maximum	5.75	5.94	12.69	12.51	17.36
min	2.82	3.63	7.48	9.10	13.47
Standard deviation	0.84	0.57	0.84	1.01	1.09
skew	0.18	0.82	-1.71	0.69	0.02
kurt	1.92	3.05	9.07	2.44	1.83
normality	3.46	7.23	129.14	5.93	3.67
P value	0.01	0.03	0.00	0.04	0.16

Source: Research finding

In this study, the ARDL method based on quantile (QARDL), introduced by Cho et al. (2015), was used to investigate the effect of variables of government oil revenue, exchange rate, and money supply (M2) on the price index (CPI and PPI), which provides the possibility of investigation of the short-term and long-term asymmetric effect on dependent variables in different quantiles. For this purpose, firstly, it was necessary, using the ADF test, to examine the existence of a unit root in the research variables, which the results are given in Table 2. The test results show that the research variables are a combination of integration variables of degree of zero and one.

Table 2. ADF test results

Variables	level		First order difference		status
	T- Statistics	probability	T- Statistics	probability	
LCPI	-1.98	0.59	-3.55	0.02	I(1)
LPPI	-0.5	0.98	-8.43	0.00	I(1)
LOIL	6.1	0.00	----	----	I(0)
LEX	-2.24	0.45	-4.91	0.00	I(1)
LM2	-1.75	0.71	-3.12	0.04	I(1)

Source: Research finding

In the following, the results of QARDL estimation, presented by Cho et al. (2015), for long-term and short-term relationship in different quantile of dependent variables, are displayed in Table 3. As the estimation results demonstrate the short-term effect of increasing oil revenues on inflation is significant in the different quantiles, thus, its affect is asymmetric. in this way, in quantile of 0.05 to quantile of 0.7, the effect is notable and positive, and in quantile of 0.8 to quantile 0.95, the effect is remarkable and negative. In other words, in periods that the inflation rate is in the lower quantiles, the increase in oil revenues, due to the increase in demand in the economy, will increase inflation, and when the inflation is in the upper quantiles, it allows the government to control and even reduce the inflation by increasing the imported goods and intervening in the

market (Karantininis et al., 2011). However, a comparison of the coefficients showed that the inflationary effect of increasing oil revenues outweighed the deflationary effects. The results of long-term estimates also confirmed the above results. The results in Table 4 presented that the effect of oil revenues on the PPI is relatively similar to that on the CPI.

The results of Table 3 showed that in the short run, the exchange rate has a positive and significant effect on the inflation, and of course, in the upper quantile, the effect is increasing. In fact, at the higher rates of inflation, the effect of the exchange rate increase is more severe. However, in the long run, the effect of the exchange rate increase on inflation from 0.2 onwards is positive and significant, and its effects are greater than in the short run. for example, in the short run, the effect of exchange rate increase on inflation in quantile 0.06 is 0.031 and in the long run is 0.613.

Examining the effect of exchange rate increase on PPI (Table 4) displays that, in the short run, this effect is positive and remarkable. on the other way, in the long run, exchange rate increases have a positive effect on PPI by increasing production costs, which is even more severe compared to CPI.

Finally, Table 3 demonstrates that increasing the M2 in the short term and in the initial quantiles (quantiles 0.0.1 to 0.2) can have a negative effect on inflation by smoothing the production path. However; the effect is greater in other quantiles. in the long run, the effect of increasing of the M2 on inflation is symmetric and non-linear and causes increase inflation. Comparison of this effect on the producer price index shows that, in the short run increasing, the M2 may have a negative effect on the PPI by increasing the resources available to manufacturing firms and increasing the amount of production; however, in the long run, the effect of increasing M2 on the PPI is positive and enhances the growth of this index.

Table 3. Results of estimating the short-term and long-term coefficients of the variables related to the CPI equation

Quantiles	ECM	Short-term coefficients			Long-term coefficients		
	$\delta_0(\tau)$	$\theta_0(\tau)$	$\theta_0(\tau)$	$\omega_0(\tau)$	$\beta_{OIL}(\tau)$	$\beta_{ER}(\tau)$	$\beta_M(\tau)$
0.05	-0.54	* 0.001	0.029	-0.053	0.002	-0.799	** 0.458
0.10	-0.53	* 0.002	0.036	-0.036	0.011	-6,540	** 0.465
0.2	-0.46	* 0.003	0.060	-0.001	0.029	** 0618	** 0.011
0.3	-0.43	* 0.008	0.060	** 0.021	** 0.081	** 0.6	** 0.209
0.4	-0.48	* 0.007	0.051	** 0.029	** 0.065	** 0.508	** 0.288
0.5	-0.49	* 0.004	** 0.034	** 0.017	** 0.063	*** 0.563	** 0.277
0.6	-0.51	* 0.004	** 0.031	** 0.011	** 0.076	*** 0.613	** 0.229
0.7	-0.54	0.003	** 0.024	0.003	** 0.085	*** 0.774	** 0.093
0.8	-0.55	-0.001	** 0.041	0.002	-0.035	*** 1,096	** 0.064

0.9	-0.54	-0.001	** 0.048	0.021	-0.018	*** 0.832	** 0.276
0.95	-0.83	-0.008	** 0.001	0.055	-0.11	** 0.013	** 0.733

*Significance at 10% level, ** Significance at 5% level, *** Significance at 1% level
Source: Research finding

Table 4. Results of estimating the short-term and long-term coefficients of the variables related to the PPI equation

Quantiles	**ECM**	**Short-term coefficients**			**Long-term coefficients**		
	$\delta_0(\tau)$	$\theta_0(\tau)$	$\theta_0(\tau)$	$\omega_0(\tau)$	$\beta_{OIL}(\tau)$	$\beta_{ER}(\tau)$	$\beta_M(\tau)$
0.05	-0.24	-0.131	0.363	0.223	-0.16	0.45	-0.28
0.10	-0.32	-0.006	0.104	-0.011	-0.04	0.84	-0.094
0.2	-0.41	0.004	0.056	-0.030	** 0.15	** 2.16	-1.16
0.3	-0.42	0.009	0.057	-0.041	** 0.81	** 5.02	-3.61
0.4	-0.46	** 0.011	0.053	-0.041	** 1.18	** 5.71	-4.46
0.5	-0.53	** 0.017	** 0.052	* -0.047	** 3.8	** 11.58	-10.4
0.6	-0.55	0.002	** 0.054	* -0.055	* 0.03	** 1.31	*** 1.31
0.7	-0.56	0.001	*** 0.061	* -0.060	-0.005	** 1.49	*** 1.47
0.8	-0.44	0.010	*** 0.054	-0.070	-0.161	** 0.83	*** 1.08
0.9	-0.56	0.028	*** 0.048	-0.080	-0.36	-0.62	*** 1.03
0.95	-0.64	0.014	*** 0.027	-0.074	-0.083	** 0.159	*** 0.438

Significance at 10% level, ** Significance at 5% level, *** Significance at 1% level
Source: Research finding

The diagnostic test data for the QARDL estimation results, based on the wald test, are gathered in Table 5. The Wald test does not have a standard asymptotic explanation. However, it makes the possibility of examining the structural changes of variables without worrying about the presence or the absence of break in the data (Gadil et al., 2021).

In this context, short-run ($Wald_{SR}$) and long-run ($Walad_{LR}$) Wald test statistics show that the effect of oil revenue and exchange rates on the CPI and the PPI is asymmetric in the short and long run. also, in the short run, the effect of increasing M2 on the CPI and the PPI is asymmetric, but in the long run, its effect is symmetric on the CPI and on the PPI is asymmetric. this result indicates the heterogeneity of the stock price index response to changes in macro variables used in the study.

Table 5. Wald test results

dependent variables			LOIL	LEX	LM
CPI	$Wald_{SR}$	Amara F	4.68	2.37	1.54
		P-value	0.00	0.00	0.02
	$Walad_{LR}$	Amara F	4.79	2.64	0.9
		P-value	0.00	0.00	0.85

PPI	$Wald_{SR}$	Amara F	4.53	2.28	2.12
		P-value	0.00	0.00	0.02
	$Walad_{LR}$	Amara F	4.22	2.42	2.33
		P-value	0.00	0.00	0.00

Source: Research finding

5. Conclusion Remarks

Considering the importance of consumer price index (CPI) and the producer price index (PPI) in the economy, in the present study, the effect of variables of government oil revenue, exchange rate and money supply on them was investigated. to achieve that objective, the quarterly data of the variables for the period of 2005:1 to 2022:1, and the QARDL method introduced by Cho et al. (2015), were used.

In this context, the research findings showed that in the short run, all the macro variables have asymmetric effects on the CPI and the PPI. Also, regarding oil revenues, the results show that in the long run, from the quantile of 0.05 to the middle quantile, the effect of this variable on inflation is increasing and then its effect decreases. Also, based on the research findings, in the long run, the increasing effect on the producer price index is greater than the consumer price index. In other words, in the long run, the manufacturing sector would suffer more due to rising prices and declining demand. Regarding the effect of oil revenue on inflation, the results are in line with various studies in this field, include Wen et al. (2021).

Respecting the existence of asymmetric effect, the results are in line with the studies of Husaini & Lean (2021), Zakaria et al. (2021), Garzon et al. (2021). Also, regarding the nonlinear effect of oil revenue on inflation, the results are in line with the study of Lacheheb & Sirag (2019).

It should be noted that, in the long run, the effect of exchange rates on the CPI and the PPI is nonlinear, while being symmetric. Because from the quantile of 0.2 to the quantile of 0.8, its effect proportionally increases and then decreases. This difference in short-run and long-run impact can be attributed to the structure of imported goods to the country. Because most of the imported goods to Iran are of intermediary and capital type, in the short run, increasing the exchange rate price, inflation expectations would provide the ground for increasing the inflation rate, and in the long run, increasing the cost price of manufactured goods, the exchange rate pass-through would be completed. These results have been seen in some other studies such as Deka & Dube (2021), and Husaini & Lean (2021). also, about the M2, the results showed that this variable on the CPI and the PP had an asymmetric effect, in the short run, and so forth, in the short term, from the middle quantile to the quantile of 0.9, its effect was positive and significant. in the long run, the results confirmed the positive effect on inflation in all quantiles; however, its effect on the PPI was from the quantile of 0.6 onwards, which indicating its asymmetric effect. these results are in line with the studies of Atrkar Roshan (2014) and Nguyen (2015).

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